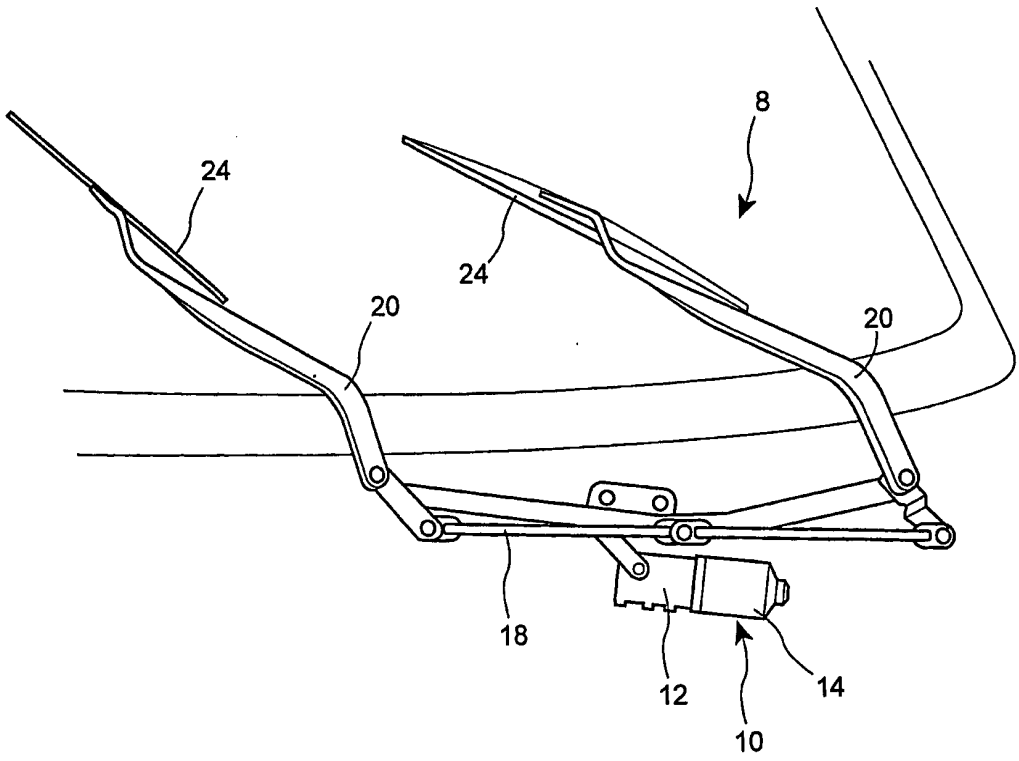

Figure 1

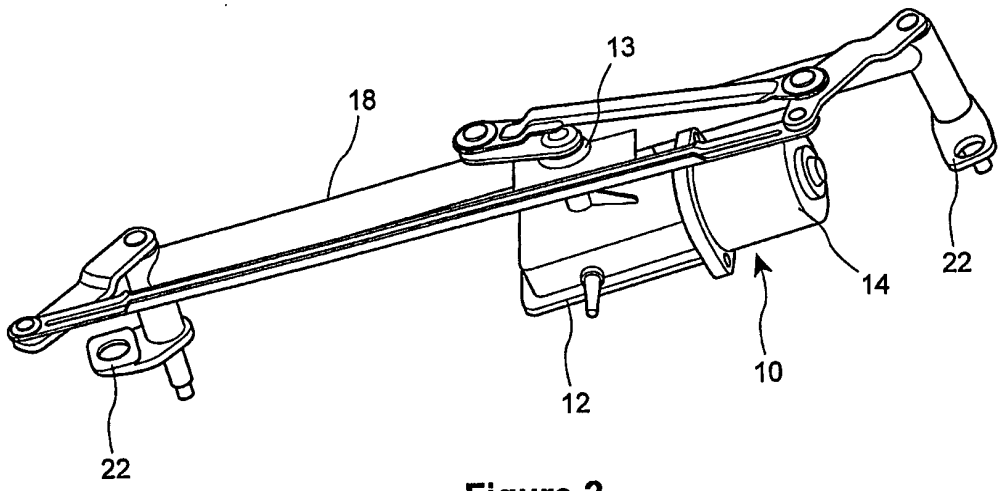

Figure 2

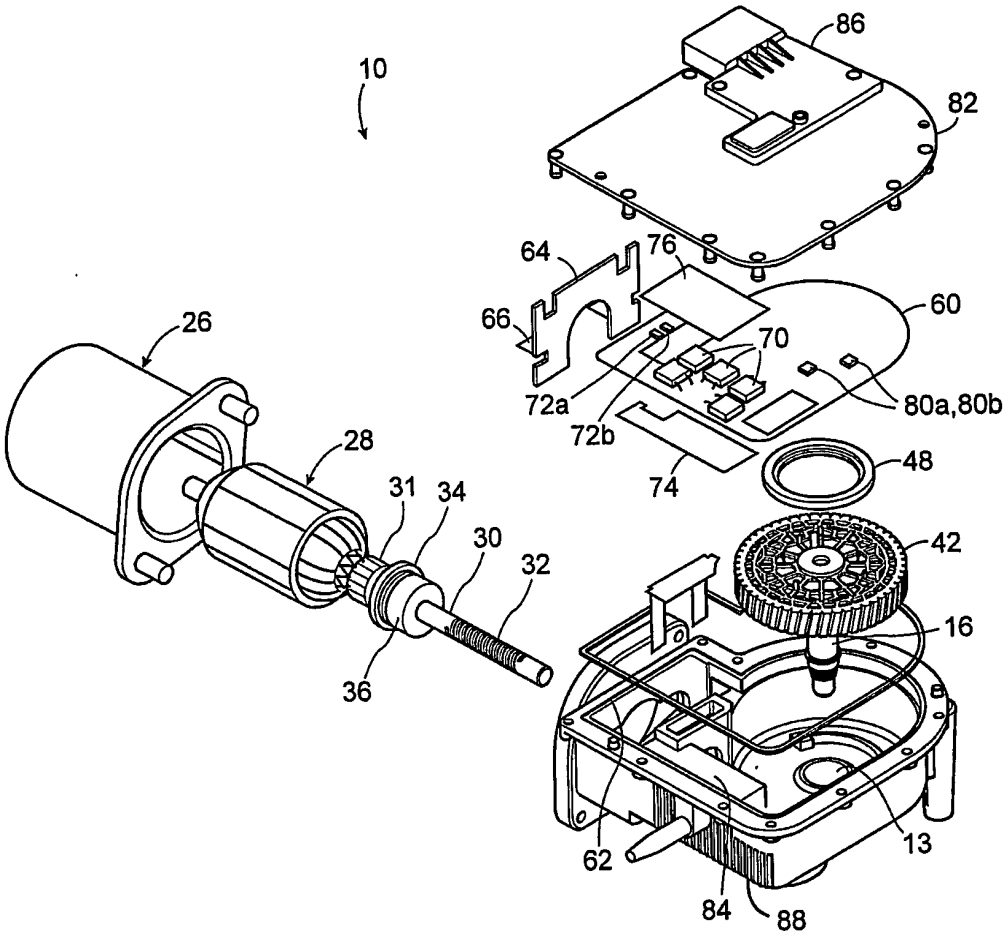
10
86
82
64
76
66
60
70
26
72a
80a,80b
72b
28
74
48
31
34
30
32
42
16
36
62
13
84
88

Figure 3

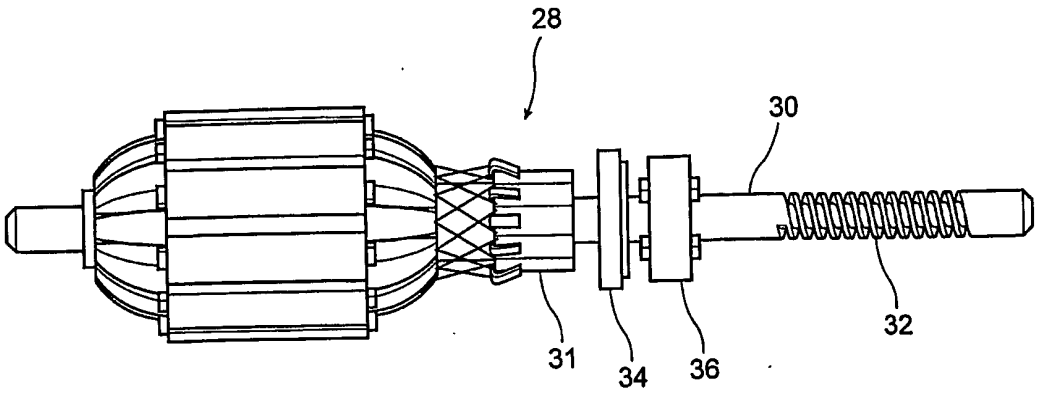

Figure 4

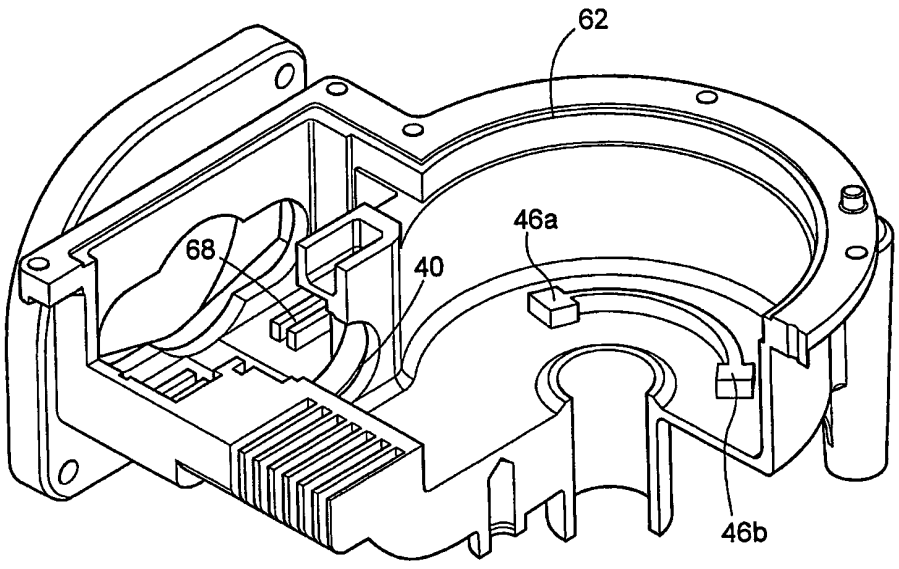

Figure 5

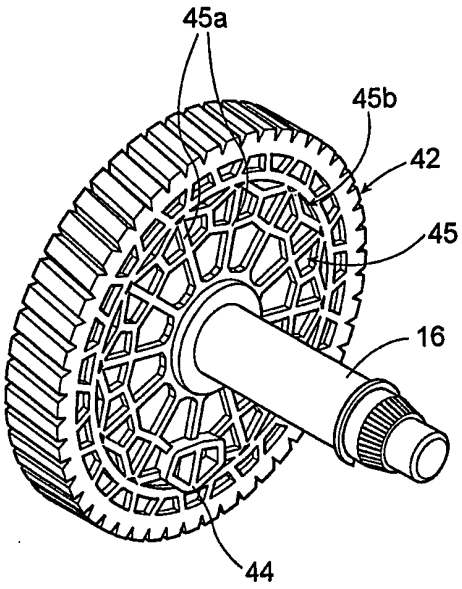

Figure 6A

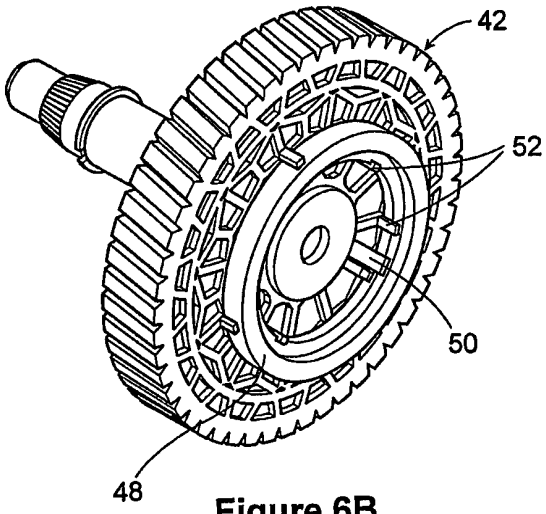

Figure 6B

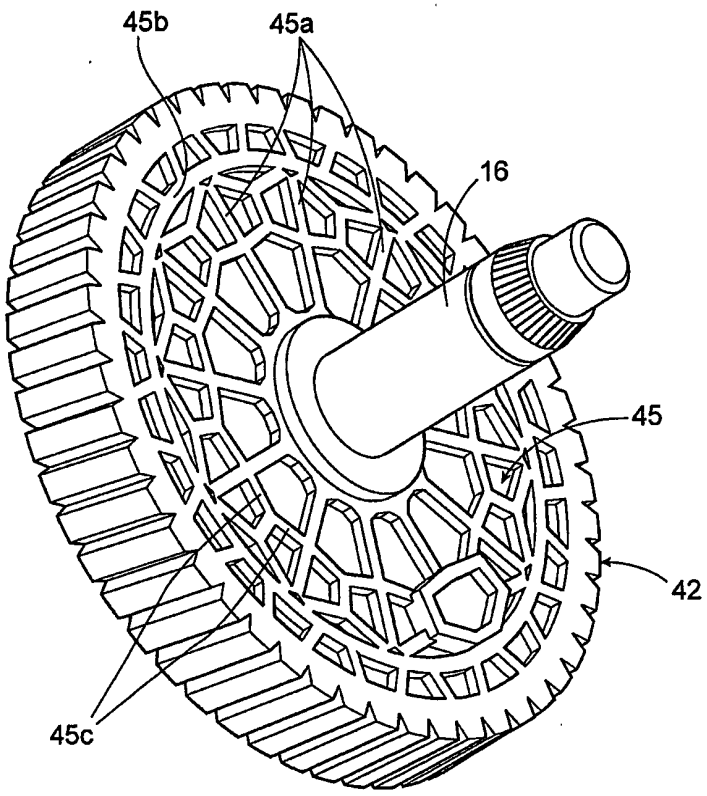

Figure 6C

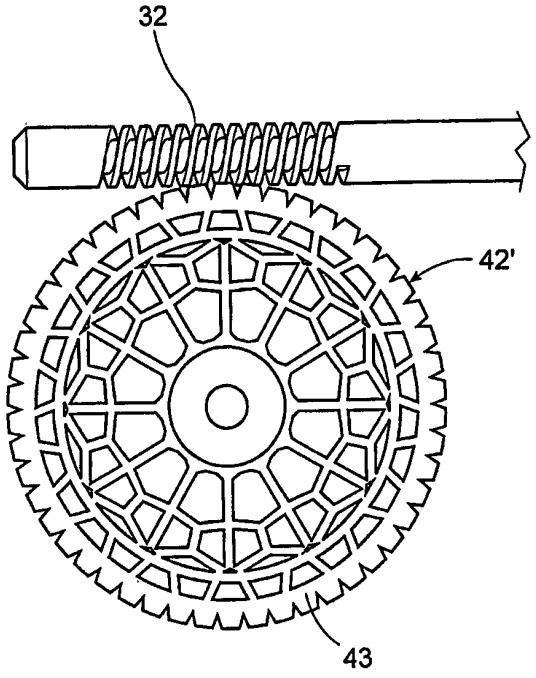

Figure 6D

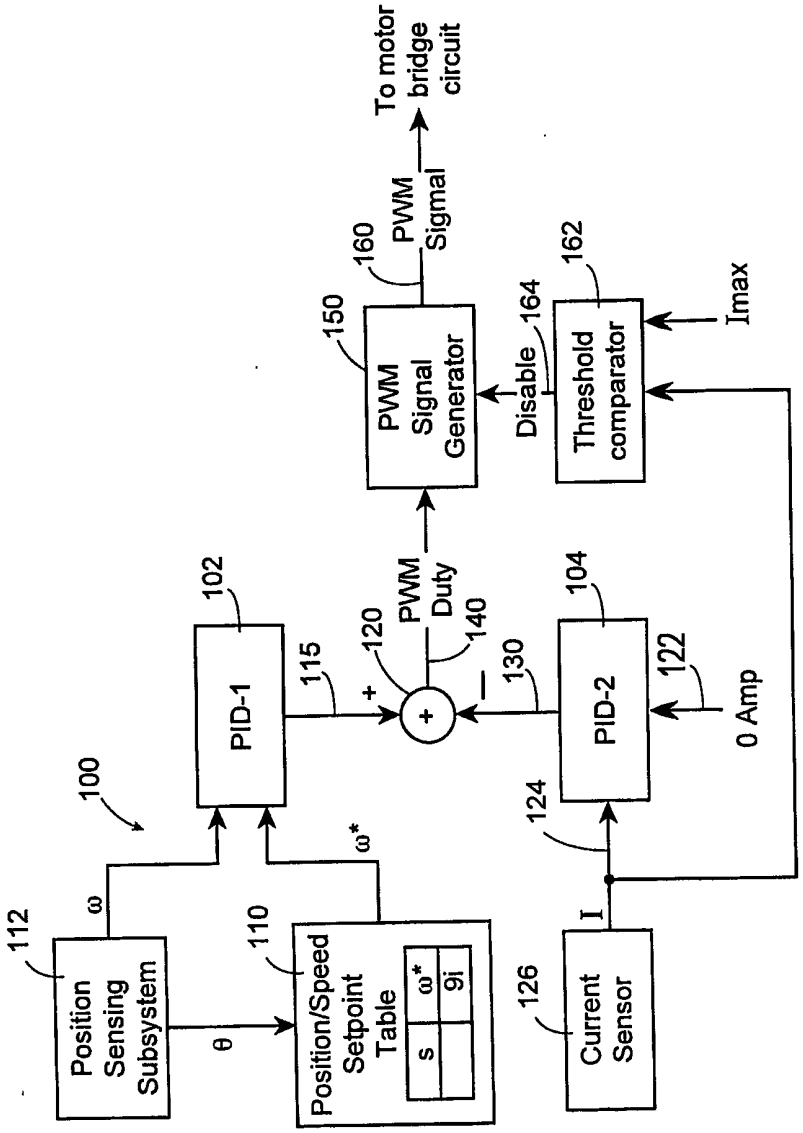
To motor bridge circuit
PWM Signal
160
150
PWM Signal Generator
Disable
164
Threshold comparator
162
Imax
PWM Duty
140
120
102
PID-1
115
+
+
−
130
PID-2
104
122
0 Amp
124
100
ω
ω*
112
110
θ
Position Sensing Subsystem
Position/Speed Setpoint Table
s
ω*
θi
I
126
Current Sensor

Figure 7

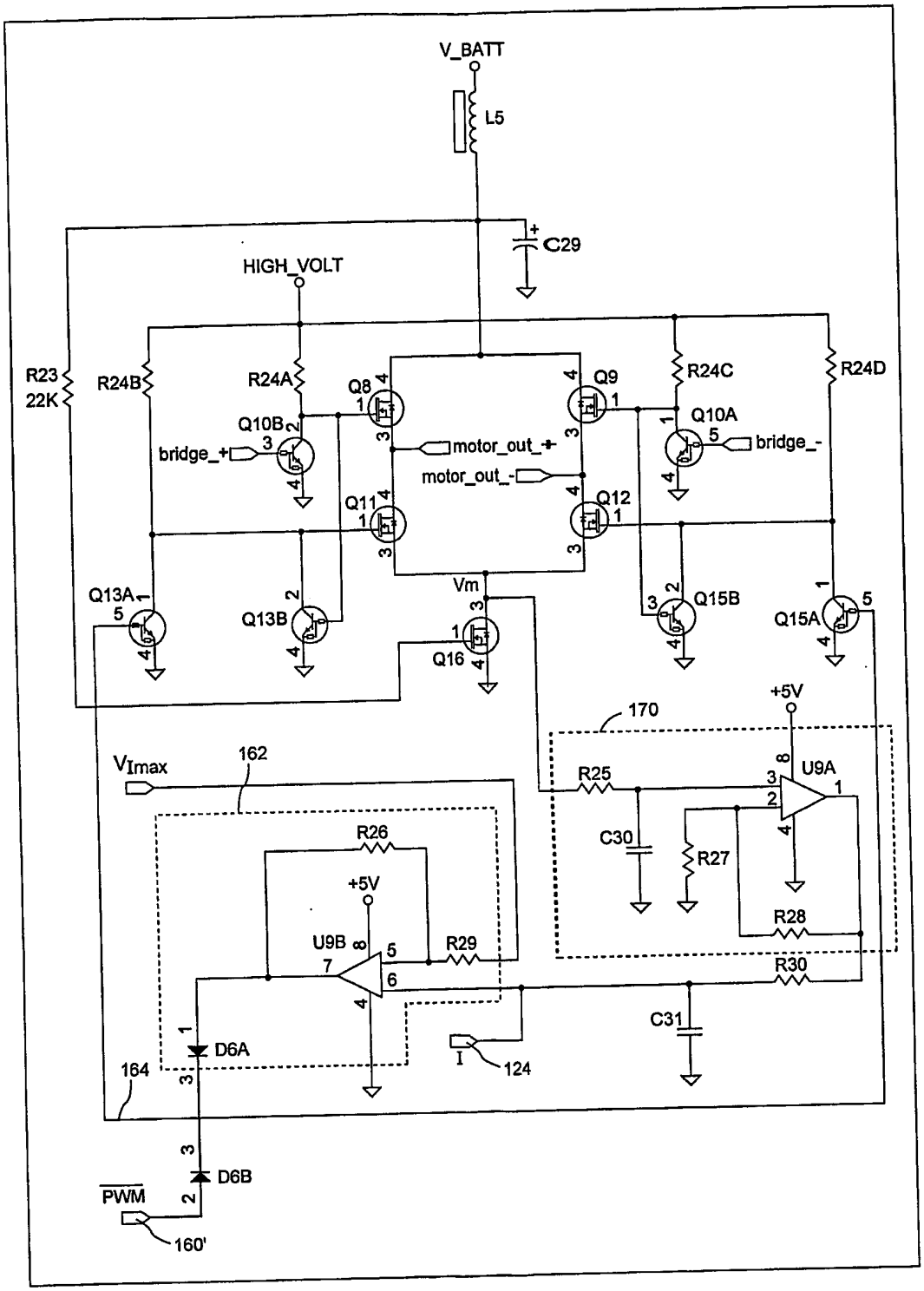
V_BATT
L5
C29
HIGH_VOLT
R23
22K
R24B
R24A
R24C
R24D
Q8
Q9
Q10A
Q10B
bridge_+
motor_out_+
motor_out_-
bridge_-
Q11
Q12
Vm
Q13A
Q13B
Q15B
Q15A
Q16
+5V
170
VImax
162
R25
U9A
C30
R27
R26
+5V
U9B
R29
R28
R30
C31
D6A
164
I
124
D6B
PWM
160'

Figure 8

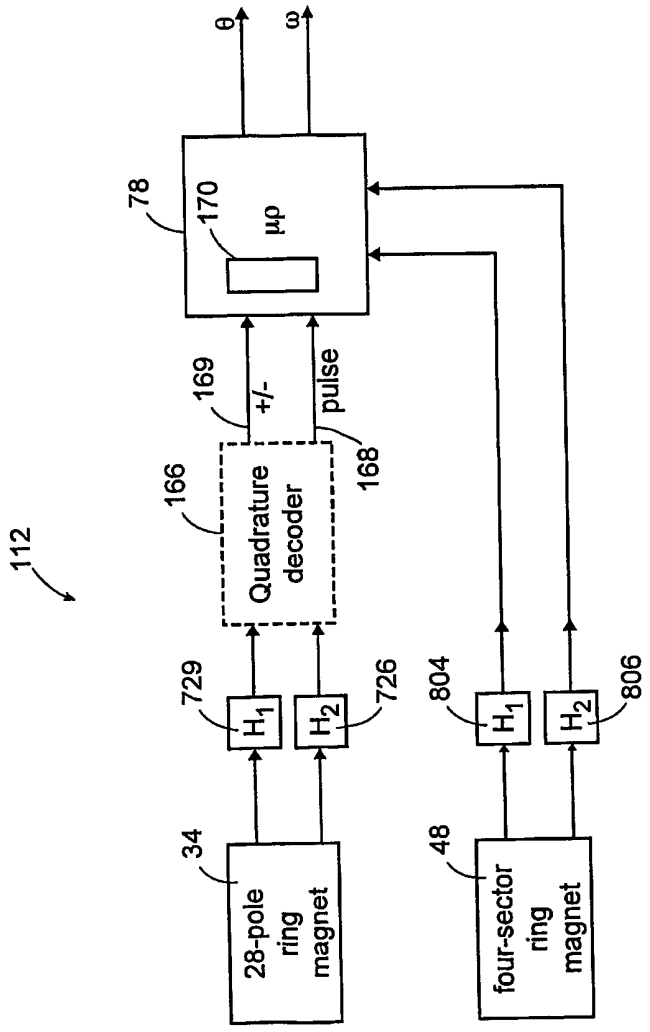
θ
ω
78
170
μp
169
+/-
pulse
168
166
Quadrature decoder
112
729
H_1
726
H_2
804
H_1
806
H_2
34
28-pole ring magnet
48
four-sector ring magnet

Figure 9

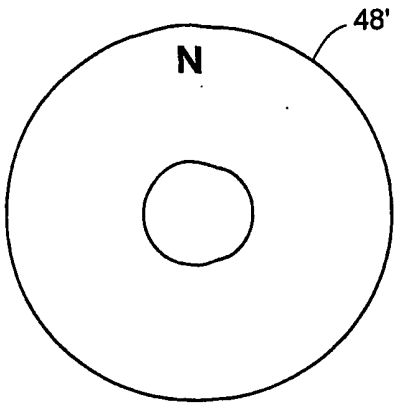

Figure 12A

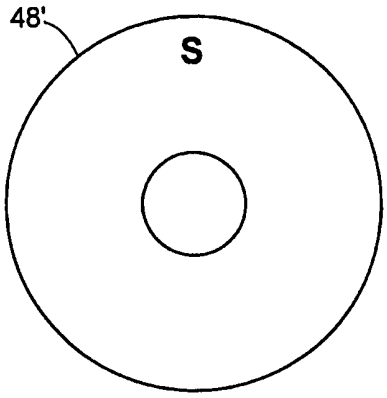

Figure 12B

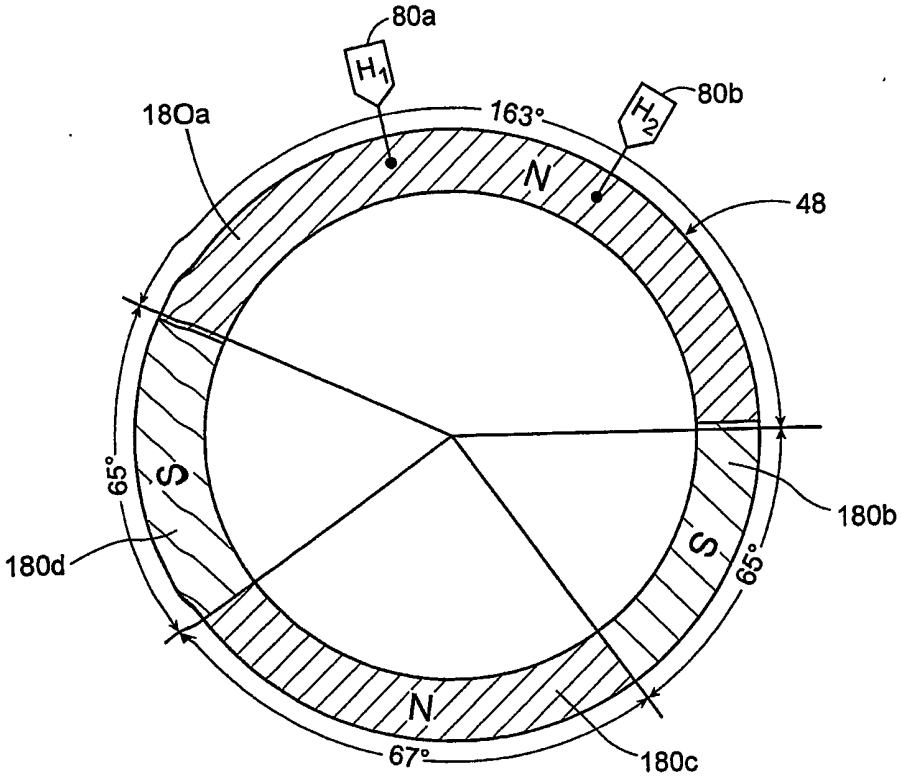

Figure 10

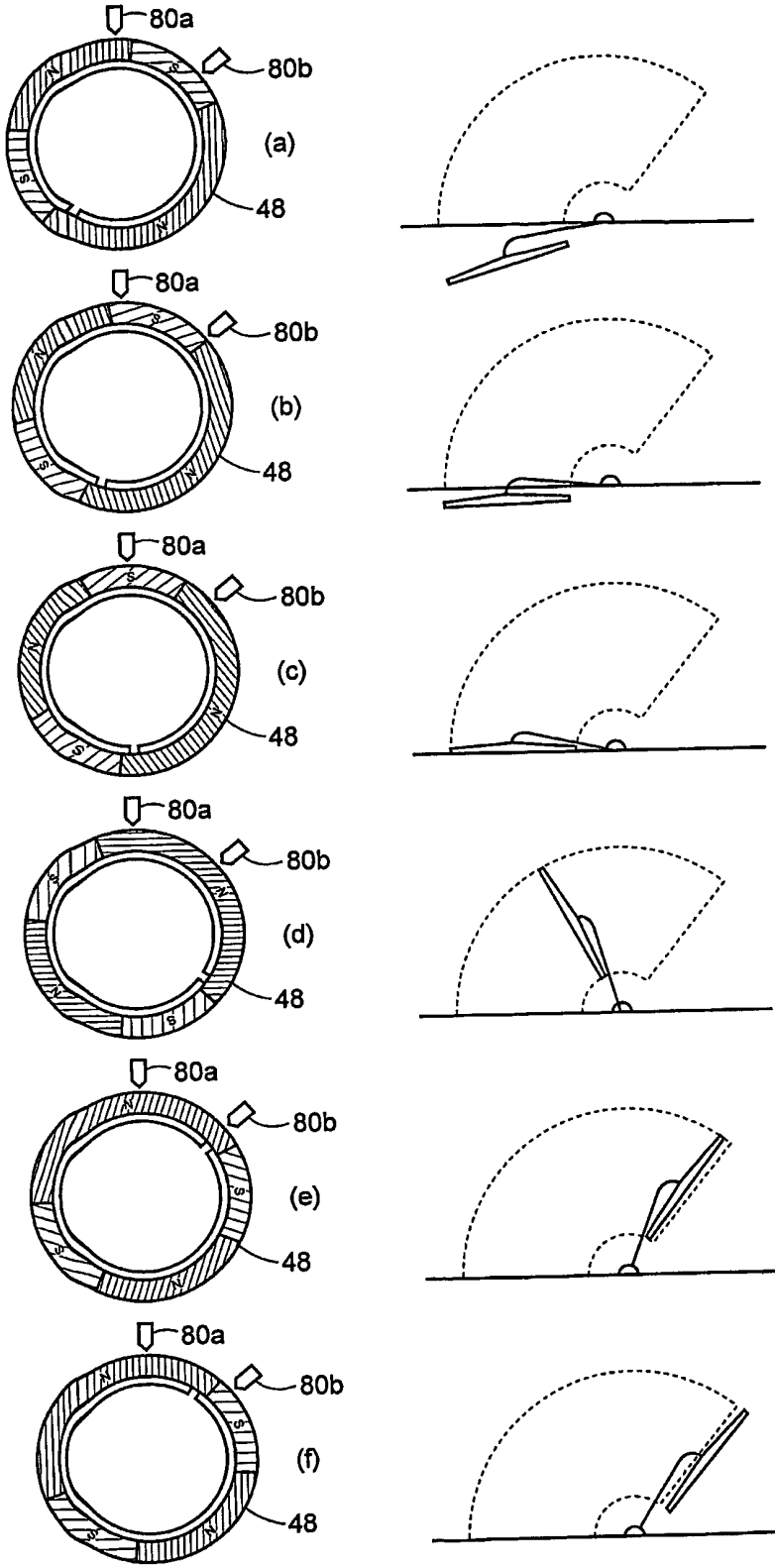
80a
80b
(a)
48
80a
80b
(b)
48
80a
80b
(c)
48
80a
80b
(d)
48
80a
80b
(e)
48
80a
80b
(f)
48

Figure 11

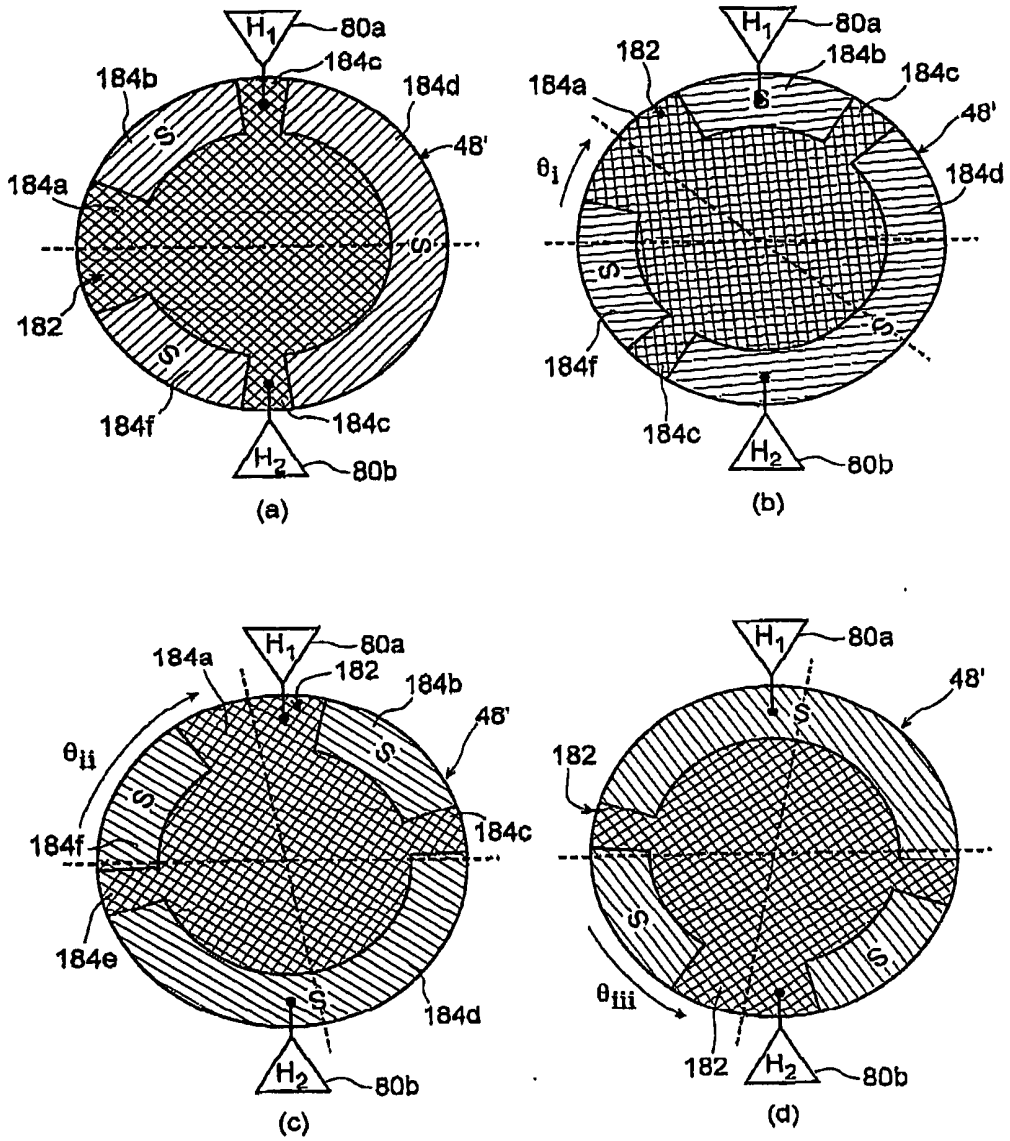
H1
80a
184b
184c
184d
48'
184a
182
184f
H2
80b
(a)
(b)
(c)
(d)
θi
θii
θiii
184e

Figure 13